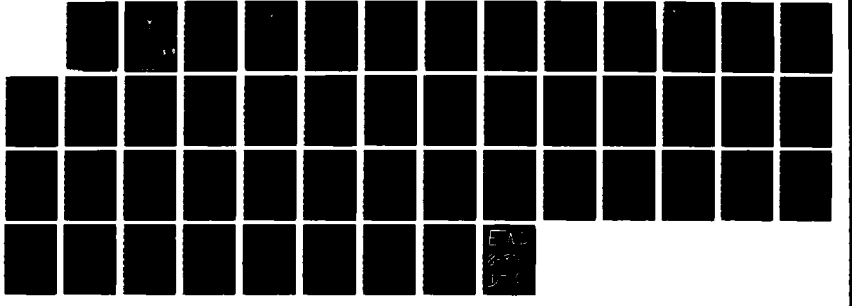
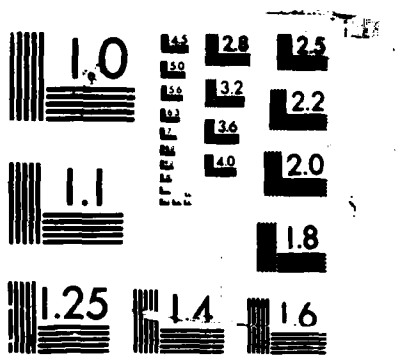
AD-A181 997 QUALITY VERSUS QUANTITY: MORE THAN MEETS THE EYE(U) AIR 1/1
COMMAND AND STAFF COLL MAXWELL AFB AL J L HUDSON
APR 87 ACSC-87-1260

UNCLASSIFIED F/G 5/9 NL





MICROCOPY RESOLUTION TEST CHART

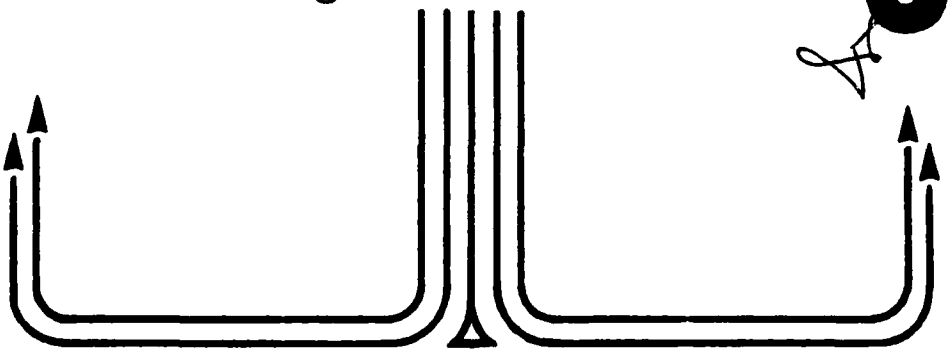
AIR COMMAND AND STAFF COLLEGE

STUDENT REPORT

QUALITY VERSUS QUANTITY:
MORE THAN MEETS THE EYE!

MAJOR JOHN L. HUDSON 87-1260

"insights into tomorrow"



DISCLAIMER

The views and conclusions expressed in this document are those of the author. They are not intended and should not be thought to represent official ideas, attitudes, or policies of any agency of the United States Government. The author has not had special access to official information or ideas and has employed only open-source material available to any writer on this subject.

This document is the property of the United States Government. It is available for distribution to the general public. A loan copy of the document may be obtained from the Air University Interlibrary Loan Service (AUL/LDEX, Maxwell AFB, Alabama, 36112) or the Defense Technical Information Center. Request must include the author's name and complete title of the study.

This document may be reproduced for use in other research reports or educational pursuits contingent upon the following stipulations:

-- Reproduction rights do not extend to any copyrighted material that may be contained in the research report.

-- All reproduced copies must contain the following credit line: "Reprinted by permission of the Air Command and Staff College."

-- All reproduced copies must contain the name(s) of the report's author(s).

-- If format modification is necessary to better serve the user's needs, adjustments may be made to this report--this authorization does not extend to copyrighted information or material. The following statement must accompany the modified document: "Adapted from Air Command and Staff Research Report (number) entitled (title) by (author) ."

-- This notice must be included with any reproduced or adapted portions of this document.

REPORT NUMBER 87-1260

TITLE QUALITY VERSUS QUANTITY: MORE THAN MEETS THE EYE!

AUTHOR(S) MAJOR JOHN L. HUDSON, USAF

FACULTY ADVISOR MAJOR ROGER F. WICKERT, ACSC/EDM

SPONSOR COLONEL CALVIN R. JOHNSON, AWC/NP

Submitted to the faculty in partial fulfillment of requirements for graduation.

AIR COMMAND AND STAFF COLLEGE

AIR UNIVERSITY

MAXWELL AFB, AL 36112

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT STATEMENT "A" Approved for public release; Distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) 87-1260	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION ACSC/EDCC 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) Maxwell AFB AL 36112-5542	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO / WORK UNIT ACCESSION NO

11. TITLE (Include Security Classification)
QUALITY VERSUS QUANTITY: MORE THAN MEETS THE EYE!

12. PERSONAL AUTHOR(S)
Hudson, John L., Major, USAF

13a. TYPE OF REPORT	13b. TIME COVERED FROM ____ TO ____	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
		1987 April	46

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The total capability of a fighter force is produced by both quality and quantity. Quantity is the order of battle; quality is composed of the level of technology in the aircraft and weapons, reliability and maintainability, aircrew training, and aircrew tactics. The US fighter force is quantitatively inferior to the Soviet fighter force. The US attempts to maintain a qualitative advantage with superior technology, superior reliability and maintainability, superior training, and superior tactics. The USSR may approach qualitative parity with new high-technology fighters such as the MiG-29 and Su-27. The USSR saves considerable time and money in aircraft development efforts by obtaining and using US technology. To maintain a qualitative advantage over the USSR, the US must continue to modernize its fighter force, train realistically, encourage tactical innovation, and restrict technology transfer to the USSR.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION	
☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS	UNCLASSIFIED	
22a. NAME OF RESPONSIBLE INDIVIDUAL ACSC/EDCC Maxwell AFB AL 36112-5542	22b. TELEPHONE (Include Area Code) (205) 293-2483	22c. OFFICE SYMBOL

DD Form 1473, JUN 86 *Previous editions are obsolete.*

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

PREFACE

The idea for this project originated with the National Security Briefing Team, whose members travel across the US to brief both civilian and military groups on national security issues. The main body of text is designed to be background reading for the members of the team. The appendix is designed to be included in the next revision of the National Security Briefing text.

The debate over the quality versus quantity issue runs very strongly in the US. This is not only a defense issue but also an emotional issue, with the high-quality advocates facing-off against the high-quantity advocates. The almost limitless amount of written material on the subject testifies to the amount of discussion on the issue.

It is only through careful analysis that the real questions and answers become apparent. The US public must be aware of the arguments on both sides of the quality versus quantity issue so that they and their representatives in Congress can make the best decisions for the nation about how much quality and how much quantity to purchase with the defense dollar. Hopefully, the briefing in the appendix can contribute to the mission of the National Security Briefing Team by providing the US public with an awareness of this important issue.

The author expresses his appreciation to Colonel Calvin R. Johnson, Chief of the National Security Briefing Team and project sponsor, and Major Roger F. Wickert, project advisor, for providing thorough and timely feedback at the various stages of the project effort.

ABOUT THE AUTHOR

Major John L. Hudson, USAF, is currently a student at the Air Command and Staff College, Maxwell AFB, AL.

He received his commission from the USAF Academy in 1973; he was a Distinguished Graduate with a Bachelor of Science in Astronautical Engineering. In 1974, he received a Master of Science in Aeronautics and Astronautics from Purdue University. In 1975, he was the Top Graduate in Sheppard AFB Undergraduate Pilot Training Class 75-08. From 1975 to 1978, he was a T-38 Instructor Pilot for German Air Force student pilots at Sheppard AFB. From 1979 to 1981, he flew the A-10 Thunderbolt II at RAF Bentwaters, United Kingdom. In 1982, he was a Distinguished Graduate of the USAF Test Pilot School. From 1983 to 1984, he was a test pilot, operations officer, and project manager for A-10 testing at Edwards AFB. From 1984 to 1986, he was an A-7 and T-38 Instructor Pilot at the USAF Test Pilot School.

He has completed the Squadron Officer School by correspondence, the Air Command and Staff College by seminar, and the National Security Management Course by correspondence.

Major Hudson and his wife Marsha have three sons: John, Timothy, and Todd.

TABLE OF CONTENTS

Preface iii
About the Author iv
List of Illustrations vii
Executive Summary viii

CHAPTER ONE--INTRODUCTION 1

CHAPTER TWO--QUALITY VERSUS QUANTITY ARGUMENTS 3
  Superior Quality Arguments 3
    Advantages 3
    Disadvantages 4
  Superior Quantity Arguments 4
    Advantages 4
    Disadvantages 5
  The US Fighter Force 5

CHAPTER THREE--DOES THE US RELY ON SUPERIOR QUALITY? 6
  Quantity Plus Quality = Total Capability 6
  Quantitative Comparison 6
    USSR Fighter Order of Battle 7
    US Fighter Order of Battle 8
  Quality of the Fighter Forces 9
    Technical Comparison 9
    Reliability and Maintainability 9
    Aircrew Training 11
    Aircrew Tactics 12

CHAPTER FOUR--WHERE ARE WE HEADING? 14
  Who's on First? 14
  Fighter Production Rates 16
    Soviet Fighter Production 16
    US Fighter Production 16
  Force Modernization 17
    USSR Fighter Modernization 17
    US Fighter Modernization 18
  A Window of Vulnerability? 19

CONTINUED

CHAPTER FIVE--THE THREAT POSED BY TECHNOLOGY TRANSFER... 20
Methods of Acquiring Technology..... 20
Technology as Policy..... 21
Beyond Mere Coincidence..... 21
Protecting Technology..... 24

CHAPTER SIX--CONCLUSIONS AND RECOMMENDATIONS..... 25
Conclusions..... 25
Recommendations..... 26

BIBLIOGRAPHY..... 27

GLOSSARY..... 32

APPENDIX--BRIEFING INSERT FOR THE NATIONAL SECURITY BRIEFING TEAM..... 33

LIST OF ILLUSTRATIONS

TABLES

TABLE 1--USSR Fighter Order of Battle..... 7
TABLE 2--US Fighter Order of Battle..... 8
TABLE 3--Comparison of Basic Technologies..... 15
TABLE 4--USSR Fighter Production Rates for 1980, 1983-1985..... 16
TABLE 5--US Fighter Production Rates for 1983-1992..... 17
TABLE 6--Future USSR Fighter Force Structure..... 18
TABLE 7--USSR/US System Development Comparison..... 23

EXECUTIVE SUMMARY

Part of our College mission is distribution of the students' problem solving products to DoD sponsors and other interested agencies to enhance insight into contemporary, defense related issues. While the College has accepted this product as meeting academic requirements for graduation, the views and opinions expressed or implied are solely those of the author and should not be construed as carrying official sanction.

"insights into tomorrow"

REPORT NUMBER 87-1260

AUTHOR(S) MAJOR JOHN L. HUDSON, USAF

TITLE QUALITY VERSUS QUANTITY: MORE THAN MEETS THE EYE!

I. Purpose: To investigate the quality versus quantity issue applied to the fighter forces of the USSR and the US. This staff study will be background reading for the members of the National Security Briefing Team. The appendix is an insert designed to be included in the next revision of the National Security Briefing.

II. Problem: The quality versus quantity issue is not well understood. A summary of the number of fighter aircraft reveals only quantitative information; it does not reveal total capability produced by both the quantity and the quality of the fighter force. Since quality is composed of several factors, each factor must be discussed before an understanding of total capability is reached.

III. Data: The USSR maintains a fighter force that is approximately 10 percent larger than the US fighter force. The US attempts to offset this numerical deficiency with a qualitative advantage. In the author's opinion, quality is

defined by several factors: the level of technology in the aircraft and weapons, reliability and maintainability, aircrew training, and aircrew tactics. In aircraft and weapon technology the US has enjoyed an advantage, but the Soviets are trying to close this gap with the introduction of two new high-technology fighters, the MiG-29 and Su-27. The US has an advantage in reliability and maintainability. US aircrews still enjoy better day-to-day training than the Soviets, although they are making efforts to improve training. US aircrews are able to employ good tactics as a result of training with realistic exercise scenarios and dissimilar air combat training. The Soviets are eroding the US advantage in basic technologies. Soviet fighter production rates are considerably higher than US fighter production rates. The Soviets are experts at obtaining US technology by overt and covert methods. By using US technology to save aircraft development time and money, the Soviets build aircraft that are very similar to US aircraft and develop them 3 to 12 years behind their US counterparts.

IV. Conclusions: The US relies on superior quality to offset the quantitative advantage of the USSR in the fighter force. Although the Soviets are trying to close the technology gap with the MiG-29 and Su-27, Soviet maintenance capabilities may be stretched thin with these high-technology fighters. The Soviets are still behind the US in aircrew training and tactics. It is possible that before the US advanced tactical fighter is fielded in the 1990s, the Soviets can field a fighter force that is superior in quantity and nearly equivalent in quality to the US fighter force.

CONTINUED

V. Recommendations: It is vitally important to the US that its fighter force maintain an edge in total capability over the Soviet fighter force. In order to be certain of a qualitative advantage, the US must have superior technology in its aircraft and weapons, superior reliability and maintainability, superior training, and superior tactics. The US must continue to modernize the fighter force by replacing old fighters with new fighters so that the Soviets will have difficulty matching the technology in US aircraft and weapons. Development of the advanced tactical fighter must continue to receive high priority and must stay on schedule. The US must emphasize reliability and maintainability for all future fighter designs. The US military must maintain realistic training environments. The US military must encourage innovative thinking to keep tactics effective and survivable. The US must work vigorously to halt technology transfer to the USSR in basic and applied technology.

Chapter One

INTRODUCTION

Does the US rely on superior quality to defeat the USSR, an opponent with superior quantity, in a conventional conflict? General Lawrence A. Skantze, Commander of the Air Force Systems Command, said, "Because the Soviets hold overwhelming leads in 'sheer numbers' of combat aircraft, the Air Force must use 'technological superiority as a force multiplier'. . . ." (29:88) Dr. James Tegnelia, the US Assistant Under Secretary of Defense for Conventional Initiatives, said, "Enhanced deterrence from conventional forces in the last part of this century is attainable by putting to use the West's greatest asset, the ability to exploit high technology." (28:650) US leaders and experts believe that against the fighter force of the USSR, the US must field a fighter force that is superior in quality in order to overcome quantitative deficiencies and win in combat.

The fighter force of the USSR is somewhat larger than the fighter force of the US. (5:19-30,36-46) However, a comparison of the quality of each force is a complicated problem. The word "quality" implies more than just the technical sophistication of aircraft and weapons. In the author's opinion, quality also involves reliability and maintainability, the training of the aircrews, and the tactics of the aircrews. Although other factors may be important, it is the author's opinion that these are the most important factors; therefore, the discussion of quality will focus on these factors.

The US has fighters such as the F-15, F-16, A-10, F-111, F-14 and F/A-18. These fighters were formerly matched against fighters such as the MiG-21, MiG-23, MiG-25, MiG-27, MiG-31, and Su-24. However, new and technologically advanced Soviet fighters such as the MiG-29 and Su-27 have emerged to pose a challenge to the US fighter force. ". . . the Su-27 and MiG-29 are often compared to the F-15, F-16 and F/A-18: the U.S. aircraft represent the Western state-of-the-art. Both Soviet fighters have Mach 2.3 speed, and the 13,600-kilogram thrust of the Su-27 engines is 25 percent higher than the thrust of the F-15." (15:122)

Although the US leads the USSR in most areas of basic technology, the lead is shrinking in many of these areas. (33:255) Production rate figures suggest that in a few years the USSR may be able to field a fighter force that in many respects approaches qualitative parity with the US fighter force. One of the reasons why the USSR has been able to make such impressive gains is that US high technology has been available for Soviet acquisition. "Hundreds of Soviet military systems and weapons of the 1980s and 1990s have benefited or will benefit from technologies obtained from the Free World." (34:110)

The Soviets use both overt and covert methods to acquire high technology from the US and other Western countries. According to Soviet Military Power 1986, "This is not a random effort, but a massive, centrally controlled campaign to obtain needed products and technical knowledge through legal and illegal means." (34:108) With Western technology, the USSR avoids costly research efforts, saves time, and produces weapons as good as or better than US weapons. (34:106)

In order to understand the problems that the US fighter force faces with the Soviet fighter force, it is necessary to examine the arguments for qualitatively and quantitatively superior forces, compare the fighter forces of the USSR and the US in terms of quality and quantity, examine the production rates and future fighter force structure of the USSR and the US, and determine the effects of technology transfer to the Soviets. Then it is possible to provide recommendations for a course of action that the US should follow in order to field a sufficiently strong fighter force for the future.

Chapter Two

QUALITY VERSUS QUANTITY ARGUMENTS

In order to understand the quality versus quantity issue, it is useful to examine the advantages and disadvantages of each approach. In Air University Review, Rebecca Strode said, "The United States has emphasized complexity, versatility, and technological sophistication and has been willing to sacrifice a certain amount of quantity in exchange for higher quality." (26:50)

SUPERIOR QUALITY ARGUMENTS

Advantages

Superior quality aircraft and weapons have certain advantages. Lesser numbers are required for the same mission results due to superior kill ratios or probabilities of kill. Some military leaders, such as Adolf Galland, a World War II Luftwaffe fighter pilot, favored quality over quantity in fighters. Galland said, in The First and the Last, ". . . superior technical achievements--used correctly both strategically and tactically--can beat any quantity numerically many times stronger yet technically inferior." (2:323) Toward the end of World War II, the Germans developed a jet-propelled fighter, the ME-262; the ME-109 was a proven propellor-driven fighter. The ME-262 was at least 120 miles per hour faster than the fastest propellor-driven fighter; the high technology of the jet engine provided this advantage. (2:326) Concerning these two fighters, Galland said, "We need quality of performance, if only to restore in our own force the sense of superiority, even if our numbers are smaller. For example to give some idea of value: At the moment I would rather have one ME-262 than five ME-109's." (2:336) Luftwaffe pilots could translate the ME-262's advantage into tactical success. ". . . the ME-262 broke again and again with ease through the American fighter screen and shot down one bomber after the other from the tightly closed formations despite an inferiority of 100 to 1." (2:352)

Some missions require high-quality fighters and weapons. For example, the North Vietnamese Thanh Hoa bridge ". . .

had been struck repeatedly during Rolling Thunder without going down." (4:59) In Air Warfare in the Missile Age, Lon Nordeen said, "Television-guided and laser-guided bombs could do the job of at least 10 times the number of unguided bombs, meaning fewer aircraft had to be exposed to the extensive North Vietnamese antiaircraft defenses." (4:59) In 1972, the Thanh Hoa bridge ". . . was finally destroyed by F-4s using laser-guided bombs." (4:63)

High-quality multirole aircraft provide operational commanders and planners added flexibility. ". . . it is beneficial to have at one's disposal aircraft that can perform a variety of missions and hence can be shifted about as necessity dictates." (26:48) Also, multirole aircraft may provide total program savings through developmental savings (one aircraft rather than several), production economies of scale, and maintenance savings through standardization. (26:48)

Disadvantages

The superior-quality aircraft and weapons have certain disadvantages. For multirole aircraft, the opportunity for mission optimization is decreased, since equipment to perform all designated missions must be carried all the time unless it is externally carried in pods. Multirole aircraft ". . . possess the capability to fulfill several missions, even though performing only one at a time." (26:48) For example, a single-mission aircraft such as the A-10 was optimized for close air support; a multirole aircraft such as the F-16 is expected to be good at not only air-to-air but also air-to-ground missions. Clearly, ". . . on any given mission, a multirole aircraft is equipped with a number of systems that are superfluous to the accomplishment of its mission." (26:48) Aircrew training will probably be more costly. Lon Nordeen said that complex fighters and weapons will ". . . not only lengthen the time required for a pilot or weapon systems operator to reach a basic level of proficiency, but also increase the need for constant practice. . . ." (4:209)

SUPERIOR QUANTITY ARGUMENTS

Advantages

A superior-quantity strategy has advantages. It allows simpler designs. ". . . single mission aircraft appear to be more cost-effective, since they need not embody 'superfluous' capabilities." (26:48) Aircrew and maintenance training are reduced. ". . . simplicity

facilitates pilot training and eases the pilot's task under the difficult conditions of combat." (26:51) More targets are presented to the enemy. The loss of a few assets is not as devastating as it is with the superior-quality strategy. It gives the capability to overwhelm defenses either in the air or on the ground. For example, an F-15 can only shoot down one enemy aircraft at a time with an AIM-7 missile since it has to illuminate the target until missile impact. (33:202) In this case, sheer numbers could overwhelm the F-15.

Disadvantages

A superior-quantity strategy has disadvantages. It can be costly for a large force of aircraft, aircrews, and maintenance personnel. When the fleet needs upgrade or replacement, a significant effort is required since large numbers of refit kits or replacement parts are needed. Some missions may not be achievable with simple aircraft no matter how many are available. For example, the simple aircraft might all be shot down by sophisticated surface-to-air missiles before reaching the target because they did not carry sophisticated electronic countermeasures equipment. For another example, a high-quality aircraft with all-weather, night-attack capability can hit targets without time or weather restrictions; a simple aircraft, although present in large numbers, may be constrained to good-weather, daylight-only attacks. In Air University Review, Rebecca Strode said single-mission fighters lose flexibility and ". . . it is preferable to perform several missions reasonably well than one superbly and others not at all." (26:48)

THE US FIGHTER FORCE

In summary, many of the quality versus quantity arguments are reflections of the other's advantages and disadvantages. Each strategy has advantages in certain situations. It was previously stated in this paper that US leaders believe the US must field a fighter force superior in quality to the fighter force of the USSR. An editorial in Defense Science & Electronics had the following statement: "Our entire defense system today is predicated on the concept that technical superiority is more valuable than numerical superiority." (20:30) The next subject to be addressed is how the US relies on superior quality to overcome quantitative inferiority.

Chapter Three

DOES THE US RELY ON SUPERIOR QUALITY?

How is the word "quality" defined? Is it aircraft aerodynamic performance, weapons capability, reliability and maintainability, or some other factor? For example, the achievement of a superior fighter operationally-ready rate with good maintenance can be a force multiplier. Is quality a combination of factors? Lon Nordeen said, ". . . tactics, countermeasures, aircrew, weapons operator training, and political factors still significantly affect how well weapons systems perform in battle." (4:209) In the author's opinion, quality is a combination of aircraft performance, weapon capability, reliability and maintainability, aircrew training, and aircrew tactics. The aircraft performance and weapon capability are determined by the level of technology used in the design of the aircraft and the weapon.

QUALITY PLUS QUANTITY = TOTAL CAPABILITY

In the author's opinion, quality plus quantity equal total capability, which is a more valid measure of a military force than order-of-battle tables or aircraft technical descriptions. In order to understand the overall picture of the total capability of the fighter forces of the USSR and the US, both quantity and quality of the fighter forces will be examined. First, numerical comparisons will be made between the USSR and the US to show the orders of battle in the fighter forces. Then, quality will be analyzed by discussing the technology in the fighter forces and weapons, reliability and maintainability, aircrew training, and aircrew tactics.

QUANTITATIVE COMPARISON

The data presented will show the orders of battle for both the USSR and the US. For the USSR, all tactical assets are counted; this count includes tactical assets in Frontal Aviation, Air Defense, Strategic Forces, and Naval Forces. For the US, all tactical assets from the US Air Force, the

US Navy, the US Marine Corps, the reserves, and the national guard forces will be counted.

USSR Fighter Order of Battle

From The Military Balance 1986-1987, the Soviets have approximately 6,680 fighters. In Table 1, the Soviet fighters are listed by type; the approximate number available and mission for each type are shown. For the sake of simplicity, all fighters assigned tasks of air defense, intercept, or other air-to-air tasks were considered to have air superiority (AS) missions. All fighters assigned tasks of interdiction, close air support, or other air-to-ground tasks were considered to have ground attack (GA) missions. From Table 1, the USSR has 3,060 fighters assigned to air superiority roles, 2,765 fighters assigned to ground attack roles, and 855 multirole fighters.

Fighter Type	Number Available[1]	Mission[2]
MiG-21/Fishbed	655	AS/GA
MiG-23/Flogger	2,080	AS
MiG-25/Foxbat	430	AS
MiG-27/Flogger	810	GA
MiG-29/Fulcrum	100	AS/GA
MiG-31/Foxhound	100	AS
Su-7/Fitter	80	GA
Su-15/Flagon	200	AS
Su-17/Fitter	975	GA
Su-24/Fencer	700	GA
Su-25/Frogfoot	200	GA
Su-27/Flanker	100	AS/GA
Tu-28/Fiddler	90	AS
Yak-28/Brewer	90	AS
Yak-38/Forger	70	AS
Total Fighters	6,680	

Notes: 1. The data sources are The Military Balance 1986-1987, reference 5, published in 1986, and Soviet Military Power 1986, reference 34, published in 1986.
2. GA = ground attack and AS = air superiority. The primary mission is listed first.

Table 1. USSR FIGHTER ORDER OF BATTLE

US Fighter Order of Battle

In Table 2, the US fighter order of battle is listed. Table 2 is similar in format to Table 1. From Table 2, the US has 1,201 fighters assigned to air superiority roles, 2,054 fighters assigned to ground attack roles, and 2,733 multirole fighters.

Fighter Type	Number Available[1]	Mission[2]
A-4/Skyhawk	186	GA
A-6/Intruder	187	GA
A-7/Corsair II	633	GA
A-10/Thunderbolt II	671	GA
AV-8/Harrier	77	GA
F-4/Phantom II	1,449	GA/AS
F-14/Tomcat	324	AS
F-15/Eagle	777	AS
F-16/Fighting Falcon	1,028	GA/AS
F/A-18/Hornet	256	AS/GA
F-106/Delta Dart	100	AS
F-111/Aardvark	300	GA
Total Fighters	5,988	

Notes: 1. The data sources are The Military Balance 1986-1987, reference 5, published in 1986, and Soviet Military Power 1986, reference 34, published in 1986.
2. GA = ground attack and AS = air superiority. The primary mission is listed first.

Table 2. US FIGHTER ORDER OF BATTLE

From the numbers in Tables 1 and 2, the fighter force of the USSR is approximately 10 percent larger than the fighter force of the US. The numbers are deceiving, however, since US fighters would most likely face Soviet fighters in a deployed situation such as in Europe, the Far East, or the Middle East; then, the Soviets would be much closer to home and could more easily apply their large number of fighters while the US would probably have a considerably smaller number of fighters on hand. Therefore, in a combat situation, the US probably would be quantitatively inferior

to the USSR. The exact ratio of forces could vary widely. Since the orders of battle have been analyzed, the next area to be examined is the technology in the aircraft and weapons of each fighter force.

QUALITY OF THE FIGHTER FORCES

Technical Comparison

The level of technology in the aircraft and weapons can be assessed by examining aircraft and weapon performance. Aircraft that are roughly equivalent in mission will be compared. The aircraft compared will be the MiG-23 and the F-4, the Su-24 and the F-111, the Su-25 and the A-10, and the MiG-29/Su-27 and F-15/F-16/F/A-18 combinations.

The MiG-23 featured extensive avionics including a pulse Doppler Highlark air intercept radar comparable to the AWG-10 in the F-4J. (15:121) In 1972, the Su-24 appeared; it resembled the US F-111 with design supporting a two-man crew, all-weather capability, terrain-following radar, large weapons load, and large internal fuel capacity. (15:122) The Su-25 resembles the US A-10 in mission but the US A-9 in form. (26:59; 27:35,38) However, its internal gun lacks the killing power of the GAU-8A cannon on the US A-10. (27:35) The latest Soviet fighters, the MiG-29 and the Su-27, possess many similarities to the US F-15, F-16, and F/A-18. They are in the Mach 2.0 class, carry beyond-visual-range missiles, have air-to-air and air-to-ground capabilities, and have sophisticated avionics with head-up displays and all-weather capabilities. (15:122) Bill Sweetman summarized, in International Defense Review, the challenge from the new Soviet aircraft: "When properly maintained and operated, the new-generation Soviet fighters close the qualitative gap the United States once enjoyed. . . ." (15:124) Since the technology in the respective fighters and weapons have been examined, the next step is to address the other factors that constitute the quality of the fighter force.

Reliability and Maintainability

Reliability and maintainability are critical factors for generation of sorties over a period of time. If a fighter force hopes to sustain a high sortie rate, maintenance must be able to generate those sorties.

The US has made a substantial investment in reliability and maintainability. The US maintenance force trains longer and is 40 percent larger; the US spends far more than the

Soviets do on maintenance equipment. (1:97) As new aircraft are developed, maintenance personnel work to develop proper maintenance procedures and equipment so when the aircraft are sent to operational units, they will be maintained efficiently. In the development of the advanced tactical fighter, its reliability and maintainability will be emphasized to produce a sortie generation rate over twice that of the F-15. (30:95) Tactical Air Command has instituted procedures to maximize sortie output. Under the Black Flag initiative, manpower is decentralized to squadron-level organic units, maintenance personnel are cross-trained, and there is less rigidity in the chain of command. (1:33) These efforts, according to Joshua Epstein, ". . . have increased combat realism and flexibility overall and have reduced turnaround times as part of the effort to maximize sortie rates under combat conditions." (1:33)

The Soviets do not appear to have made the investment in reliability and maintainability the US has made. The Soviets have not made an adequate investment in modern support equipment; instead, they depend on each individual unit to manufacture needed equipment. (1:97) This approach has many disadvantages. Each unit has their own equipment which is not standardized with other units. (1:97) The unit would have severe difficulties in wartime while attempting to cross-service other types of Soviet aircraft since the unique maintenance support equipment would most likely be unsuitable for other types of aircraft. (1:72) Maintenance personnel new to the unit would not be familiar with the non-standardized equipment, so they would need training on this equipment. If a unit deploys, the maintenance personnel will have to bring their own equipment with them, since they would not be trained to use the support equipment at the deployment base. (1:71)

The Soviets use a flow-line approach to post-flight maintenance. (1:89) Each maintenance person has a predetermined task to accomplish in a predetermined amount of time. Unanticipated combat damage or breakdowns will disrupt the maintenance schedule and affect the sortie rate. "The flow-line method is . . . ill-equipped to handle uncertainty without severe effects on either performance (sortie effectiveness), sortie rates, or both." (1:95)

The US seems to lead clearly in reliability and maintainability. In Airman, Major General Schuyler Bissell compared US maintenance personnel to Soviet maintenance personnel: "Our enlisted technicians, on the other hand, get involved with the entire gamut of aircraft generation and repair. They are integral to the business of flying and fighting." (12:8) The new generation of Soviet

fighters may cause severe problems for the Soviets. "The Su-27 and MiG-29 may rival the performance of the F-15 and F/A-18, but the new-generation aircraft could strain Soviet training, supply, and maintenance organizations." (15:121)

Aircrew Training

Aircrew training is the next additional factor to be considered; it is a critical part of the total capability equation. "Modern technological marvels, without an adequately trained crew, are just so much metal sitting on the apron." (4:209) In this paper, comments on aircrew training will be directed toward the continuation training program, which is the day-to-day training that operational aircrews receive.

In the US, both Air Force and Navy pilots participate in large-scale exercises which are frequently of a joint nature and feature dissimilar air-to-air combat exercises and challenging air-to-ground attack scenarios. (32:--) Exercises such as Red Flag at Nellis AFB, REFORGER in Germany, and Team Spirit in Korea, provide US aircrews with a high degree of realism in training. Flying time also has an impact on pilot skills. US Air Force fighter pilots average twice as much flying time per year as Soviet fighter pilots. (1:xxvii) Even with realistic exercise scenarios and high flying time averages, the US military has experienced very low accident rates in recent years. In fiscal 1986, the Defense Department had the safest flying year in its history, even as more sorties involved low-level flying, large formations, adverse weather conditions, and the use of night-vision devices. (14:12) The US has found a good balance between training realism and flight safety; high-quality aircrews are training with high-quality fighters and weapons.

The Soviet aircrew continuation training program does not compare well with the US program. The Soviet system works against providing realistic training for their aircrews because they are more concerned with high ratings on operational evaluations and low accident rates. (1:99-103) Therefore, training routines and operational evaluations become constant and simple. For example, the Soviet solution to flying safety problems in intercept training was to prohibit complex aerial maneuvering by either aircraft during the intercept. (1:106) Although the intercept then becomes simple, its training value greatly decreases. (1:106) Dr. Epstein noted that because the Soviets practice intercepting a much-simplified enemy, high ratings are received in safety and interception, but ". . . the net result is routinized and unrealistic training, low

combat skill, and operational rigidity." (1:106-107) However, the Soviets are implementing changes in operational training as they upgrade and develop new fighters such as the MiG-29 and Su-27. (24:83) Even with these changes, the US still retains a substantial advantage in air-to-air training. Soviet aerial engagements resemble basic fighter maneuvering; the importance of sophisticated dissimilar air combat training, which US fighter aircrews train extensively with, was emphasized in a 1977 Rand Corporation report. (24:88; 35:23)

Training and tactics are closely related. "Through training, ideally the crew melded with the aircraft into an integral team of man and machine, whose performance is honed to a fine edge through tactics." (4:209) Training and tactics achieve a synergistic effect. "Training and tactics therefore play an interrelated role: training to achieve proficiency in tactics, while tactics themselves often evolve from vigorous training." (4:209) Next, tactics will be addressed.

Aircrew Tactics

The tactics used by the aircrews play an important role in the determination of total capability. Lon Nordeen said, ". . . the all-important measure of aircrews of any nation, regardless of the technological level of its aircraft and weapons, is the proficiency and tactics with which the aircrew is able to maneuver and utilize the weapons systems to defeat the enemy." (4:209)

In aircrew tactics, the Soviets remain behind the US. While the US aircrew has the advantage of realistic training to develop and practice innovative, survivable, and effective tactics, the Soviet aircrew has been restricted to routine exercises and training. (1:101-102; 24:87-88; 32:--) Dr. Epstein feels strongly about the tactical skill issue: "It cannot be overemphasized that, historically, superior pilot skill (technological superiority aside) has proven to be more than the equivalent of numbers." (1:110) A Rand Corporation researcher said in a 1977 study, ". . . pilot skill is perhaps the critical element in air-to-air combat." (35:10) In Steven Rosen's work, What a Fifth Arab-Israeli War Might Look Like: An Exercise in Crisis Forecasting, he said, ". . . differences in equipment and hardware technology are swamped by differences in pilot skill under all but the most unfavorable force ratios." (36:22) While the quantity of aircraft and technology in the aircraft and weapons are important, the tactical skill of the aircrews is a critical part in the evaluation of total capability. The Soviets have made efforts to improve their tactical

concepts. They have begun to stress initiative and realism: they emphasize the offense. (24:87-88) Their study of tactics resembles US tactical initiatives in the 1970s. (24:83) The Soviets are training their aircrews in more sophisticated tactical concepts, such as modern formation concepts and more freedom from ground control. (24:88) However, US aircrews still have a clear advantage in tactics.

Analysis of the orders of battle for the USSR and US fighter forces shows that the Soviets have approximately a 10 percent advantage, although that advantage would probably be larger in combat situations far from the US and near the USSR. The US appears to hold advantages in aircraft technology, reliability and maintainability, training, and tactics; the US has an advantage, therefore, in overall fighter force quality. Since these relationships may change with time, it is important to examine trends in quality and quantity.

Chapter Four

WHERE ARE WE HEADING?

How does the US stack up technically? Secretary of Defense Caspar Weinberger listed some areas of basic technology with military application; it appears that the US has a lead in most areas critical to fighter operations, but is losing the lead in some areas. (33:255) From an analysis of basic technology, it is appropriate to examine fighter production rates and trends in production figures. From this examination, future fighter force structure may be projected.

WHO'S ON FIRST?

In Table 3, basic technologies that may have an impact on the fighter forces are listed together with an indication of how the US compares to the USSR in each area. Although the US currently holds an advantage in most areas, it is losing the advantage in four areas and only improving the advantage in one area. If the USSR can close the gap in basic technologies, it may be able to close the gap in applying technology to aircraft and weapons.

Type of Basic Technology	US/USSR Comparison[1,2] US Superior	US/USSR Equal	USSR Superior
Aerodynamics/Fluid Dynamics		x	
Computers and Software	<-- x		
Conventional Warheads		x	
Electrooptical Sensors	x		
Guidance and Navigation	x		
Life Sciences (Human Factors)	x		
Materials	x -->		
Microelectronics and Integrated Circuits	x -->		
Optics		x	
Power Sources		x	
Production and Manufacturing	x		
Propulsion	x -->		
Radar Sensors	x -->		
Robotics	x		
Signal Processing	x		
Signature Reduction	x		

Notes: 1. The source for this data is reference 33, page 255. These technologies are available for application and have potential for improving military capability.
2. The arrows show that the relative standing is changing in the direction indicated. The judgements represent consensus in each area of basic technology.

Table 3. COMPARISON OF BASIC TECHNOLOGIES

FIGHTER PRODUCTION RATES

US fighter production figures for previous years are found in reference sources such as U.S. Military Aircraft Data Book 1986; estimates for future years are taken from annual five-year defense plans. USSR fighter production figures for previous years are found in reference sources such as Soviet Military Power 1986; estimates for future years are an educated guess at best. In this paper, estimates of future USSR fighter production figures are strictly the author's opinion.

Soviet Fighter Production

Soviet production rates for previous years are shown in Table 4. The figures were drawn from Soviet Military Power 1986.

Year	Number of Fighters Produced[1]
1980	1,300
1983	950
1984	800
1985	650

Note: 1. Data taken from reference 34, page 120.

Table 4. USSR FIGHTER PRODUCTION RATES FOR 1980, 1983-1985

Soviet fighter production has decreased from 1980 to 1985. However, Bill Sweetman wrote in International Defense Review that US analysts believe Soviet fighter production will return to the late-1970s peak of 1,200 fighter aircraft per year as the new types become established. (27:35)

US Fighter Production

US fighter production rates for 1983 to 1992 are shown in Table 5. The figures for 1983 through 1986 are actual data; the figures for 1987 are planned figures. The figures for 1988 through 1992 were taken from the five-year defense plan submitted with the budget for fiscal year 1988.

Type	Year									
	83	84	85	86	87	88	89	90	91	92
A-6E/F	8	6	6	11	6	12	18	24	24	36
AV-8B	21	27	32	46	47	32	32	15	15	15
F-14A/D	24	24	24	18	18	12	12	19	30	42
F-15 all	39	36	42	48	48	42	42	42	42	42
F-16 all	120	144	150	180	180	180	180	180	180	150
F/A-18	84	84	84	84	102	84	72	72	72	72
Total	296	321	338	387	401	362	356	352	363	357

Note: 1. Data taken from references 3, 17, 23, and 31.

Table 5. US FIGHTER PRODUCTION RATES FOR 1983-1992

FORCE MODERNIZATION

USSR Fighter Modernization

Table 6 shows one possible scenario for Soviet fighter production through 1994. Several assumptions have gone into this scenario. A total of 650 fighters per year will be produced for the various Soviet fighter forces. Other fighters not included in the 650 figure may be produced for export. The total fighter force of approximately 6,680 fighters will remain constant. If the total force level is allowed to grow, not only will the Soviets have many MiG-29 and Su-27 fighters, but they could have a substantial number of still very capable fighters such as the MiG-23 and MiG-27. In this scenario, the production rate figures vary as follows: for the MiG-23, 100 per year through 1989 then 0 per year; for the MiG-29, 300 per year through 1989 then 350 per year; for the Su-25, 50 per year; for the Su-27, 200 per year through 1989 then 250 per year. In this scenario, the Soviets could replace most currently existing MiG-21, Su-17, MiG-23, and MiG-27 aircraft by 1994. The fighter force would then be composed of approximately 4,200 highly capable MiG-29 and Su-27 fighters, 630 MiG-23s, 430 MiG-25s, 100 MiG-31s, 700 Su-24s, 550 Su-25s, and 70 Yak-38s.

	Number by Year[1]							
Type	87[2]	88	89	90	91	92	93	94
MiG-21	655	375	75	0	0	0	0	0
MiG-23	2080	2180	2280	2080	1780	1480	1180	630
MiG-25	430	430	430	430	430	430	430	430
MiG-27	810	700	600	425	250	75	0	0
MiG-29	100	400	700	1050	1400	1750	2100	2450
MiG-31	100	100	100	100	100	100	100	100
Su-7	80	0	0	0	0	0	0	0
Su-15	200	200	200	200	200	200	100	0
Su-17	975	975	725	525	350	175	0	0
Su-24	700	700	700	700	700	700	700	700
Su-25	200	250	300	350	400	450	500	550
Su-27	100	300	500	750	1000	1250	1500	1750
Tu-28	90	0	0	0	0	0	0	0
Yak-28	90	0	0	0	0	0	0	0
Yak-38	70	70	70	70	70	70	70	70
Total[3]	6680							

Notes: 1. Production: MiG-23 = 100 per year through 1989 then 0 per year. MiG-29 = 300 per year through 1989 then 350 each per year. Su-25 = 50 per year. Su-27 = 200 per year through 1989 then 250 per year. Total fighter production for Soviet forces = 650 per year.
2. 1987 figures are from references 5 and 34.
3. The total number of Soviet fighters remains constant at 6680.

Table 6. FUTURE USSR FIGHTER FORCE STRUCTURE

US Fighter Modernization

US production rates are by no means unimpressive. According to the most recent five-year defense plan, over 350 fighters will be produced per year over the next five years. (23:--; 31:--) Although the US plans to eventually expand the number of tactical fighter units, the new aircraft coming off the production lines can be used to replace older aircraft and update the overall technical level of the fighter force. (23:--; 31:--) For example, the F-16 and F-15 are replacing older aircraft such as the F-4. (31:24) The US Navy is buying the F-14D and F/A-18 to

upgrade their fighter force. (23:28) The A-7 and F-16 may be modified to provide a replacement for the A-10. (10:19)

The weapons that complement the aircraft need continued modernization. The need for the advanced medium-range air-to-air missile (AMRAAM) is a good example. The US urgently needs the AMRAAM to replace the AIM-7. The AMRAAM will gives US fighters a radar missile launch-and-leave capability, which no US fighters except the F-14 possess now. (33:202) US fighters do possess an excellent launch-and-leave capability with infrared-seeking missiles. "With AMRAAMs, . . . air-superiority fighters will be able to engage multiple targets in quick succession and maneuver out of enemy range immediately on launching their missiles." (16:79) The AMRAAM would prove most useful in a few-versus-many situation. For the air-to-ground mission, it is critical that weapons receive more attention. Technically superior aircraft dropping older weapons can achieve good results. (32:--) However, tanks are difficult to destroy with older weapons. (25:96) F-16s and A-10s need modern weapons with multiple-target kill capability to survive and be effective in the modern high-threat battlefield. (25:95)

A WINDOW OF VULNERABILITY?

The US is in the process of fielding an advanced tactical fighter (ATF) which will be a significant improvement over the F-15/F-16/F/A-18 generation. (25:95) Initial operational capability is scheduled for the mid-1990s. As the analysis of Table 6 suggests, there may be a time frame in the 1990s when the Soviets can produce enough of their new fighters, the MiG-29 and Su-27, to maintain quantitative superiority and approach qualitative parity. It is important that the ATF deployment continue to receive high priority and stay on schedule so the US can maintain an advantage in technology through the 1990s.

General Robert W. Bazley, former Commander-in-Chief of Pacific Air Forces, expressed caution about Soviet production figures and what they mean for the future. He said, "At some point, raw numbers can be made to prevail! Because of this, I see our responsibility clearly: to continue to produce the world's best fighters, . . . and produce them in sufficient numbers--a tough task. . . ." (11:81) Soviet production of advanced-technology fighters has made qualitative parity a possibility. Some of the Soviet capability to manufacture these new fighters comes from their ability to obtain high technology from Western sources.

Chapter Five

THE THREAT POSED BY TECHNOLOGY TRANSFER

The threat posed by technology transfer is very real--it can be seen in current Soviet weapon systems such as the MiG-29 and Su-27. The Soviets saved tremendous time and money on the development of these fighters. According to Soviet Military Power 1986, ". . . by using documentation on the US F-18 fighter, Soviet aviation and radar industries saved five years of development time and 35 million rubles (the 1980 dollar cost of equivalent research activity would be $55 million). . . ." (34:109) The exploitation of F-18 radar technology was critical to the development of the new fighters, since radar is the heart of the avionics system. "The documentation on the F-18 fire control radar served as the technical basis for new look-down/shoot-down engagement radars for the latest generation of Soviet fighters. . . ." (34:109) Sue Hannifin said in Armed Forces Journal International, "The Soviets have acquired and are using some of the most advanced US avionics in the technology of electronic countermeasures and counter-ECM. . . ." (18:52) There is no doubt that technology transfer to the Soviets poses a threat to the US fighter force.

METHODS OF ACQUIRING TECHNOLOGY

The Soviets acquire technology by overt means such as studying technical publications and buying unrestricted equipment and manuals. This information is supplemented by covert methods such as spying, stealing parts, and buying through fronts. The Soviets are particularly good at taking existing Western military products and reengineering to exploit these products. (21:103)

The Soviets are experts at acquiring US technology by legal means. (34:108) The US is ". . . an open society where the free exchange of information is expected." (9:17) The Soviets have several easy approaches to obtaining the needed technology. Scientific and technical publications such as Aviation Week and Space Technology are excellent sources of information on new technology. Conventions such as the annual symposium of the Society of Experimental Test Pilots, where unclassified but very valuable information is

freely discussed, are also excellent sources of information. The US has gone to great lengths to reduce secrecy. "The Freedom of Information Act unleashed a torrent of information available for the asking, and a requestor doesn't even have to be an American citizen." (9:17) The Soviets can even mail order useful technical information. "The Russians . . . can buy our latest technology from the Apple computer salesman at any Italian Computerland." (20:33)

Some information is gathered by covert methods. Examples of these methods include spying, stealing parts or whole systems, and buying parts or whole systems from former or current US allies. (21:103; 34:108) Then, reengineering is used to manufacture the system or make improvements on other systems.

TECHNOLOGY AS POLICY

In many cases, high technology is used as an instrument of national security policy. Examples of this include F-16 sales to Venezuela and Pakistan, F-14 sales to Iran, and arms sales to the People's Republic of China. Although the US military did not necessarily like to see these weapons systems sold, the political situation dictated that the sales take place. The F-14 sale to Iran is an excellent example of losing technology due to changes in political alignment. When the F-14 was originally sold to Iran, the Shah was firmly in power. When the Shah was overthrown, the new regime still had the F-14 weapon system; the USSR was able to obtain F-14 weapon system technology from Iran. (15:124). It is certainly possible that a similar experience awaits F-16 technology.

BEYOND MERE COINCIDENCE

The products of technology transfer can appear in obvious manners. In several cases, the development of Soviet systems has conveniently followed similar US systems. "Every one of them could have been submitted to meet US Air Force requirements drafted in the late 1960s or early 1970s." (27:38) The designs of the Soviet Su-27 and MiG-29 bear remarkable resemblance to the US F-15, F-16, and F/A-18. "The shift to Western fighter design culminated in the Su-27 Flanker and MiG-29 Fulcrum. . . ." (15:122) "The Su-24 Fencer that appeared in 1972 was more noticeably a Western design, and the surprising source for the Fencer was the controversial and much-maligned TFX, the F-111." (15:122) The Su-25 Frogfoot resembles the US A-9, which

lost a flyoff competition to the A-10. "Frogfoot is an equivalent to the Fairchild Republic A-10A in some ways." (27:35) "The Su-25 is the A-X." (27:38) Even in other areas of aviation, such as transports and space, the Soviets have used US technology. The Soviet Il-76 is similar to the US C-141. The Soviet An-124 Condor is similar to the US C-5. "Compared with the C-5, Condor has almost the same fuselage length and width, but has about 25% more power and a larger wing." (27:38) The Soviets have even designed their space shuttle in a manner similar to the US space shuttle. (34:49-50)

In Table 7, first flight dates and initial operational capability dates for US and USSR systems are plotted for comparison. Soviet types are listed below similar US types. Although the exploitation of the F-18 technology is probably the most famous example of technology transfer, it can be seen that other Soviet systems also follow US systems. The time lag between US and Soviet development of similar fighters ranges from 3 to 10 years. In the transport cases, the Soviets have lagged similar US transport development by 8 to 12 years. The Soviet shuttle is expected to fly in 1987 and therefore will lag the US shuttle by six years. (34:51)

Type	Year of First Flight and IOC[1,2]	Time Lag[4] (Years)
	1965 1970 1975 1980 1985	
F-15	#——*	
Su-27	%——$	10
F-16	#——*	
F-18	#——*	
MiG-29	%——$	3
F-111	#——*	
Su-24	%—$	7
A-10	#——*	
Su-25	%——$	5
C-141	#——*	
IL-76	%——$	8
C-5	#—*	
An-124	%——$	12
US Shuttle	#—*	
USSR Shuttle	%[3]	6

Notes:
1. IOC = initial operational capability. Data sources: references 6, 7, 8, 15, and 34.
2. US first flight = #. US IOC = *. USSR first flight = %. USSR IOC = $.
3. Expected date is 1987. (34:51)
4. The time lag is measured from the US system date to the Soviet system date; it is averaged between the first flight time lag and the IOC time lag.

Table 7. USSR/US SYSTEM DEVELOPMENT COMPARISON

PROTECTING TECHNOLOGY

New developments such as stealth technology will make the ATF possible. Ray Braybrook said, "'Stealth' considerations are much more important in the case of the ATF, since it will be more concerned with operating at medium altitudes over long ranges." (13:21) Dr. Donald A. Hicks, Under Secretary of Defense for Research and Engineering, said regarding stealth technology, ". . . we must continue to keep it secure. The promise of enhanced deterrent capability that it provides will be compromised by any unauthorized release of information." (19:71) It is critical that the stealth technology be closely protected so the USSR does not have the opportunity to use this US technology to negate a significant US technical advantage.

Future foreign military sales should receive careful attention for potential technical compromise. Political leaders should be made aware of the military implications of technical compromise.

There are some preventive measures that have been initiated to help stem the tide of technology flow to the USSR. For example, the US has established a technology security policy. (34:151) The Defense Technology Security Administration oversees exports while safeguarding technology. (34:151) International efforts at technology security are conducted through the Coordinating Committee on Export Controls. (34:154) US and international efforts toward technology security have a dual effect. The USSR is forced to spend more money and time to develop new weapon systems; the US saves money and time by not having to develop countermeasures to weapon systems the Soviets have developed from stolen Western information. (34:154) The US Air Force tries to safeguard information through increased education of personnel concerning technology security. (9:19) However, due to the open nature of our society, free exchange of information will continue to provide the Soviets with some degree of technical information directly applicable to military systems.

Chapter Six

CONCLUSION AND RECOMMENDATIONS

CONCLUSIONS

The US relies on superior quality in its fighter forces to offset the quantitative advantage of the USSR fighter forces. The term "quality" implies a great deal more than just the technology in an aircraft and weapon--it involves reliability and maintainability, aircrew training, and aircrew tactics.

From the order of battle of data, the Soviets fighter force is approximately 10 percent larger than the US fighter force. In aircraft and weapon technology the US has enjoyed an advantage, but the Soviets are trying to close this gap with the introduction of two new high-technology fighters, the MiG-29 and Su-27. Soviet reliability and maintainability lags US standards and may be stretched thin with the introduction of these new fighters. Although US fighter forces train with more realistic scenarios than Soviet fighter forces, Soviet leaders have begun to institute more aggressive training programs that may enable Soviet pilots to use better tactics.

The US lead in some areas of basic technology is being eroded by the Soviets. The US is modernizing its fighter force by introducing updated fighters such as the F-15E and F-16C and new weapons such as the AMRAAM. From Soviet fighter production projections, it is possible that before the ATF is fielded in the mid-1990s, the Soviets could field a fighter force that rivals the US fighter force in quality and exceeds the US fighter force in quantity.

With overt and covert methods, the Soviets have been able to obtain US high technology. As a result, they have saved considerable time and money in the development of fighters and other systems. Many Soviet aircraft resemble US aircraft; the Soviet aircraft are produced 3 to 12 years after their US counterparts. This time lag is enough for the Soviets to apply to aircraft development the technology they have obtained from the US. The US government has established a technology security policy and agencies to oversee technological security efforts.

RECOMMENDATIONS

It is vitally important to the US that its fighter forces maintain an edge in total capability over the Soviet fighter forces. Since the US cannot match the Soviets in quantity, it must maintain the advantage in quality. The US must have superior technology in its aircraft and weapons, superior reliability and maintainability, superior aircrew training, and superior aircrew tactics. The US must continue to modernize the fighter fleet by replacing old fighters with new fighters so the Soviets will have difficulty matching the technology in US aircraft and weapons. The ATF development must continue to receive high priority and stay on schedule so the US can maintain an advantage in aircraft technology through the 1990s. The US must emphasize reliability and maintainability for all future fighter design efforts. The US military must maintain realistic training environments. The US military must encourage innovative thinking to keep tactics effective and survivable. The US must work vigorously to halt technology transfer to the USSR in basic technology and applied technology. General T. R. Milton summarized the issue in Air Force Magazine: "The entire short history of air warfare confirms that victory follows the most technically advanced adversary rather than the most heavily armed." (22:99)

BIBLIOGRAPHY

A. REFERENCES CITED

Books

1. Epstein, Joshua M. Measuring Military Power: The Soviet Air Threat to Europe. Princeton, New Jersey: Princeton University Press, 1984.

2. Galland, Adolf. The First and the Last. New York: Henry Holt and Company, 1954.

3. Nicholas, Ted G. U.S. Military Aircraft Data Book, 1986. Fountain Valley, California: Data Search Associates, 1985.

4. Nordeen, Lon O., Jr. Air Warfare in the Missile Age. Washington, DC: Smithsonian Institution Press, 1985.

5. O'Neill, Robert. The Military Balance 1986-1987. Latchworth, England: The Garden City Press Ltd., 1986.

6. Taylor, John W. R. Jane's All the World's Aircraft 1969-70. New York: McGraw-Hill Book Company, 1970.

7. -----. Jane's All the World's Aircraft 1975-76. New York: Franklin Watts, Inc., 1970.

8. -----. Jane's All the World's Aircraft 1985-86. New York: Jane's Publishing, Inc., 1986.

Articles and Periodicals

9. Allsup, Dan, MSgt, USAF. "The Great High-tech Giveaway." Airman (October 1986), pp. 16-19.

10. "Battle Brews Over Follow-On Close Air Support Aircraft." Aviation Week & Space Technology (February 2, 1987), p. 19.

CONTINUED

11. Bazley, Robert W., Gen, USAF-Ret. "Why 'von Spangenberg' is All Wet." Armed Forces Journal International (June 1986), pp. 78-81.

12. Bissell, Schuyler, Maj Gen, USAF. Interview. Airman (October 1986), pp. 8-9.

13. Braybrook, Roy. "The Cutting Edge: New Fighter Technologies for the 90's." Defense & Foreign Affairs (May 1986), pp. 20-22.

14. Budahn, D. J. "1986 Safest Flying Year: DoD Accidents Drop 11%." Air Force Times (December 22, 1986), p. 12.

15. Bussert, Jim. "Can the USSR Build and Support High Technology Fighters?" Defense Electronics (April 1985), pp. 121-130.

16. Canan, James W. "The Opening Rounds." Air Force Magazine (April 1986), pp. 76-82.

17. Ginovsky, John. "Fighters, Cargo Planes Sought in Budget Request." Air Force Times (January 19, 1987), pp. 29-30.

18. Hannifin, Sue Butler. "Ideas Are There, Not Dollars, for Future Military Aircraft." Armed Forces Journal International (January 1986), pp. 46-52.

19. Hicks, Dr. Donald A. "Stealth - Its Implications for the Future." Armed Forces Journal International (September 1986), pp. 70-71.

20. "Our High-Tech Edge." Defense Science & Electronics (July 1984), pp. 29-35.

21. Jacobson, Dr. Roy S. "Soviet Military R&D: A Perpetual Follower of U.S. Initiatives?" Signal (December 1984), pp. 103-107.

CONTINUED

22. Milton, T. R., Gen, USAF-Ret. "Forecasting for Security." Air Force Magazine (August 1986), p. 99.

23. North, David M. "Navy Opts for Aircraft Carriers Over Modifications, Weapons." Aviation Week & Space Technology (January 12, 1987), pp. 27-28.

24. Pennington, Rana J., Capt, USAF. "Closing the Tactics Gap." Air Force Magazine (March 1984), pp. 83-88.

25. Schemmer, Benjamin F. and Wikner, Dr. N. F. "What Should NATO do About Conventional Weapons?" Armed Forces Journal International (December 1984), pp. 83-102.

26. Strode, Rebecca V. "Soviet Design Policy and its Implications for U.S. Combat Aircraft Procurement." Air University Review (January-February 1984), pp. 46-61.

27. Sweetman, Bill. "New Soviet Combat Aircraft - Quality with Quantity?" International Defense Review (1/1984), pp. 35-38.

28. Tegnelia, Dr. James A. "Emerging Technology for Conventional Deterrence." International Defense Review (5/1985), pp. 643-652.

29. Ulsamer, Edgar. "Progress, Priorities, and Fantasies." Air Force Magazine (January 1986), pp. 86-91.

30. -----. "Shaping the Future." Air Force Magazine (January 1987), pp. 94-98.

31. "USAF Revises Goal of Acquiring 40 Fighter Wings by Early 1990s." Aviation Week & Space Technology (January 12, 1987), pp. 24-25.

Official Documents

32. Tactical Air Command. Combat Capability Improvements. Langley AFB, Virginia: HQ TAC, 1986.

33. Weinberger, Caspar W. Annual Report to the Congress: Fiscal Year 1987. Washington DC: Government Printing Office, 1986.

34. -----. Soviet Military Power 1986. Washington DC: Government Printing Office, 1986.

Other Sources

35. deLeon, Peter. The Peacetime Evaluation of the Pilot Skill Factor in Air-to-Air Combat R-2070-PR. Santa Monica, California: Rand Corporation, 1977.

36. Rosen, Steven J. What a Fifth Arab-Israeli War Might Look Like: An Exercise in Crisis Forecasting, Center for Arms Control and International Security Working Paper no.8. Los Angeles, California: University of California, 1977.

B. RELATED SOURCES

Books

Dunnigan, James F. How to Make War. New York: Quill Company, 1983.

Luttwak, Edward N. The Pentagon and the Art of War. New York: Simon & Schuster Inc., 1985.

Shaw, Robert L. Fighter Combat Tactics and Maneuvering. Annapolis, Maryland: Naval Institute Press, 1985.

CONTINUED

Articles and Periodicals

Bingham, Price T., Lt Col, USAF. "NATO Needs a New Air Interdiction Approach." Armed Forces Journal International (October 1986), pp. 98-112.

Canby, Dr. Steven L. "The Operational Limits of Emerging Technology." International Defense Review (6/1985), pp. 875-880.

Condom, Pierre. "Powering the Light Combat Aircraft." Interavia (1/1984), pp. 27-28.

"Don Q II." "Why von Spangenberg is Right On." Armed Forces Journal International (June 1986), pp. 78-81.

Farman, Wyatt E. H. "Challenges Great for Future Aircraft: ATF, ATB, TAV." Defense Science and Electronics (March 1986), pp. 28-32.

Gilson, Charles, and Wanstall, Brian. "The Fighter Update Market." Interavia (12/1985), pp. 1311-1319.

Harvey, David S. "Fighter." Defense & Foreign Affairs (May 1985), pp. 22-29.

-----. "The Genie's Out of the Bottle." Defense & Foreign Affairs (February 1985), pp. 18-22.

Hoey, Brian, Capt, USAF. "Checkmating the Soviet Mindset." Airman (October 1986), pp. 10-13.

Lambert, Mark. "The Small Combat Aircraft: Kamikaze or War-winner?" Interavia (1/1984), pp. 35-37.

"von Spangenberg, Marconi." "USAF's 'Fighter Mafia' Needs a New Aircraft Design Philosophy." Armed Forces Journal International (March 1986), pp. 64-68.

Wanstall, Brian. "The 'Affordable' Fighter Market." Interavia (1/1984), pp. 23-26.

GLOSSARY

TERM	MEANING
AFB	air force base
AIM	air intercept missile
AMRAAM	advanced medium-range air-to-air missile
An	Antonov (Soviet design bureau)
AS	air superiority
ATF	advanced tactical fighter
GA	ground attack
GAU-8A	30 millimeter cannon found in A-10
Il	Ilyushin (Soviet design bureau)
MiG	Mikoyan-Gurevich (Soviet design bureau)
mm	millimeter
Su	Sukhoi (Soviet design bureau)
Tu	Tupolev (Soviet design bureau)
US	United States
USAF	United States Air Force
USSR	Union of Soviet Socialist Republics
Yak	Yakovlev (Soviet design bureau)

APPENDIX

BRIEFING INSERT FOR THE NATIONAL SECURITY BRIEFING TEAM

BRIEFING INSERT FOR THE NATIONAL SECURITY BRIEFING TEAM

QUALITY VERSUS QUANTITY: MORE THAN MEETS THE EYE!

INTRODUCTION

US leaders believe that to win in combat against the fighter forces of the USSR, an opponent with quantitative superiority, the US must field a fighter force that is superior in quality. General Lawrence A. Skantze, Commander of the Air Force Systems Command, has said that the US needs technical leverage against a foe who clearly outnumbers the US. While quantity can be described in a listing of numbers of aircraft by type, quality is more complicated--it involves the technology in the aircraft and the weapons, reliability and maintainability, the aircrew training, and the aircrew tactics. The US fighter force is challenged by new high-technology Soviet fighters, the MiG-29/Fulcrum and the Su-27/Flanker. The US is modernizing its fighter forces and will introduce the advanced tactical fighter in the mid-1990s. However, the Soviet fighter force may be able to approach qualitative parity with the US fighter force before the advanced tactical fighter is fielded. The US must work to maintain a technical advantage since the USSR is an expert at obtaining US technology by legal and illegal means.

QUALITY VERSUS QUANTITY

There are many arguments both pro and con for high-quality fighter forces. On the pro side, there are certain missions that can only be accomplished with sophisticated fighters. Multirole fighters provide commanders with great flexibility; they can also provide total program savings through production economies of scale and maintenance standardization. On the con side, it is difficult to optimize a multirole fighter for all of its missions. Aircrew training costs will be higher.

TOTAL CAPABILITY

The total capability of a fighter force is determined by both quantity and quality. While quantity is just pure numbers, quality is determined by the technology in the airframe and weapons, reliability and maintainability, aircrew training and aircrew tactics.

The Soviets possess approximately 10 percent more fighters than the US. However, in a combat situation far from the US and close to the USSR, the US would probably be seriously inferior in numbers. The US has normally enjoyed an advantage over the USSR in airframe and weapon technology. For example, in the late 1970s and early 1980s, the US was fielding the F-15, F-16, and F/A-18; it was not until the mid-1980s that the Soviets fielded comparable weapon systems, the MiG-29 and Su-27. The US spends more on maintenance equipment, trains its personnel better, and uses initiatives designed to maximize sortie generation. The US possesses an advantage in the training and tactical areas. US fighter aircrews fly roughly twice as much as Soviet aircrews; US aircrews train more realistically--they fly in challenging worldwide air-to-air and air-to-ground exercises in conjunction with other US military forces. However, the Soviets are changing their training and are starting to use more realistic scenarios.

WHERE WE ARE HEADING

Although the US is equal to or superior to the USSR in most areas of basic technology, the USSR is eroding this lead in many of these areas. USSR fighter production rates exceed US fighter production rates. The US is attempting to modernize its fighter force with aircraft such as the F-15E, F/A-18, and F-14D. The US plans to introduce the advanced medium-range air-to-air missile, which will give its fighters a launch-and-leave radar missile. New standoff air-to-ground weapons are needed for the ground attack mission in the modern high-threat battlefield. The USSR may be able to replace most of its fighter fleet with new MiG-29 and Su-27 fighters by the mid-1990s. The US plans to deploy the advanced tactical fighter, a great leap in fighter capability, in the mid-1990s. It is possible that before advanced tactical fighter deployment, the USSR fighter force may approach qualitative parity with the US fighter force.

TECHNOLOGY TRANSFER

Perhaps the most famous case of technology transfer was the loss of F/A-18 data to the Soviets. The US government estimates that this data saved the Soviets five years of development time and the equivalent of $55 million. The Soviets are experts at obtaining US technology by legal and illegal means. For example, the Soviets study technical journals, buy unrestricted parts on the open market, and spy on industry to obtain useful technical data and products. They use this information to build their own weapon systems.

The US occasionally sells high-technology systems to foreign countries as part of national security policy. The danger is that the system may be compromised in a manner similar to what happened to the F-14 system when the Shah of Iran fell after F-14s were sold to Iran. Today, F-16s are sold to many countries around the world. It is certainly possible that a similar fate awaits F-16 technology.

Soviet systems often mirror US systems. They tend to lag US first flight dates and initial operational capability dates by 3 to 12 years, which is enough time for the Soviets to obtain the needed technology and adapt it for their own use. The latest generation of Soviet fighters, the MiG-29 and Su-27, resembles the US F-15, F-16, and F/A-18 in airframe performance, radar capability, and appearance. The MiG-29 was developed less than two years behind the F/A-18. The Soviet Il-76 transport is very similar in dimensions and appearance to the US C-141. The Soviet space shuttle is similar to the US space shuttle.

KEEPING THE LEAD

It is vitally important to the US that its fighter forces maintain an edge in total capability over the Soviet fighter forces. Since the US cannot match the USSR in quantity, the US must maintain the advantage in quality. The US must have superior technology in its aircraft and weapons, superior reliability and maintainability, superior training, and superior tactics. The US must continue to modernize its fighter force so the Soviets will have a difficult time matching the technology in US aircraft and weapons. The development of the advanced tactical fighter must continue to receive high priority and must stay on schedule. The US must emphasize reliability and maintainability for all future fighter design efforts. The US military must maintain realistic training environments. The US military must encourage innovative thinking to keep tactics effective and survivable. The US must work vigorously to halt technology transfer to the USSR in basic technology and applied technology. The following quote from General T. R. Milton, USAF, Retired, summarizes why the US must maintain the advantage in technology: "The entire short history of air warfare confirms that victory follows the most technically advanced adversary rather than the most heavily armed."

END

8-87

DTIC